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ABSTRACT

A study investigated the role of visual imagery in the comprehension and retention of prose. Subjects were 48 fifth grade students who orally read a story and then completed three comprehension tasks directly related to the story: a retelling, an oral reading cloze test, and a multiple choice question test comprised of items demonstrated to be story dependent. After the retelling task, the subjects were asked to report any memorable images from the story. These reports were used to identify subjects who reported an image of the story's climax and those who did not. Findings indicated that reported climax imagery was related to deeper levels of processing on reading comprehension measures that do not rely on verbal reasoning processes. The results provide support for several theories of the functional use of imagery in reading. (FL)

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An Exploratory Study of the Relationships Between Reported Imagery and the Comprehension and Recall of a Story In Fifth Graders

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ABSTRACT

Relationships are investigated between naturally occurring reported images, a variety of reading comprehension measures, and a verbal mental ability test in forty-eight suburban grade five students. Students orally read a story and then perform reading comprehension tasks directly related to the story presented in counterbalanced order. Reports of imagery are used to identify two groups: subjects who report an image of the story's climax and subjects who do not. Multivariate techniques are used to determine group differences on variables, detect relationships, and control for intervention. Findings indicate that reported original climax imagery in this study is related to deeper levels of processing on reading comprehension measures that do not heavily rely on verbal reasoning processes. Support is suggested for several contemporary theories of the functional use of imagery in reading. Speculations are forwarded for the manner in which imagery interacts with verbal processes in story comprehension and recall, and for the way in which imaging might be related to miscuing in oral reading.

Renewed attention has recently been devoted to the role of visual imagery in explaining the comprehension and retention of prose text. Numerous studies have shown visual imagery to be a functionally significant device in the understanding and recollection of verbal material in words (Bugelski, 1968; Paivio, 1969; Johnson, 1970; Bower, 1970), in phrases (Paivio, 1969; Begg, 1972), in sentences (Begg and Paivio, 1969; Begg, 1971; Anderson, 1971; Anderson and Hidde, 1971; Cunningham, 1972a; Levin, et al., 1973), and in paragraphs (Pompi and Lachman, 1967; Yuille and Paivio, 1969; Montague and Carter, 1973; Steingart and Glock, 1979). However, only a few studies have dealt with the effects of imagery on extended prose texts in classroom settings (Anderson and Kulhavy, 1972; Kulhavy and Swenson, 1975) or on children reading stories in such settings (Pressley, 1976; Linden and Wittrock, 1981). These studies have generally employed imagery training or assigned the use of imagery as an experimental condition; virtually none have approached reported imagery from a naturalistic perspective without manipulation of this variable. As Schallert (1980) points out, imagery instructions, and in fact any instructions that ensure deep semantic processing of the text, have been found to result in better performances when compared to control group instructions. The present exploratory study attempts an approach in which the relationships between imagery and story comprehension in fifth-graders are investigated through a melding of both discovery and verification research modes, somewhat as described by Guba (1978, pp. 6-8). Such an approach allows for the assessment of relevant story imagery in children without a priori assumptions, for the generation and testing of hypotheses that emerge

during the study in an ecologically valid manner, and for the investigation of a variety of relationships between imagery and reading comprehension.

Method

Subjects

Forty-eight students in grade five from a suburban school are selected. A model of deliberate sampling for heterogeneity (Cook and Campbell, 1979) is employed to insure a wide and representative range of student abilities. Subjects are equally divided into three groups, (N=16) with each group having equal numbers of males and females, and high, average, and low ability readers. Analysis of variance determines group equality in verbal mental ability as determined by the Otis-Lennon School Ability Test (1979) ($F = .044$, $df = 2/45$, NS), and on the reading subtest of the Metropolitan Achievement Test (1978) ($F = .979$, $df = 2/45$ NS). Post hoc analysis of variance on reading comprehension indicators derived during the study also reveals no significant differences among these three groups on reading comprehension variables (See Note 1.).

Materials

The subjects are asked to read a complete story taken from a fifth grade basal reader ("Freddie Miller, Scientist," Betts and Welch, 1965). The story is approximately 1400 words in length, and has been identified as one which is not specific to any cultural group and uses standard language (K. Goodman and Y. Goodman, 1978). The story appears to require no background knowledge not available to the subjects in order to be comprehensible.

The story concerns the plight of a boy scientist whose frequent

home experiments go awry and get him into trouble. In the end, the boy becomes the family hero when he aids his sister, who has become locked in a closet, by constructing a home-made flashlight and lowering it to her through the transom vent above the closet door. The story contains three illustrations. Two depict experiments at the beginning and middle of the story, and the third is a diagram of the home-made flashlight. This illustration shows only the components of the flashlight and does not illustrate the climactic event in which the flashlight is used.

Design

The three groups are assigned to read the story orally and then complete three comprehension tasks: a retelling of the story, a post oral-reading cloze selection taken from the story, and a multiple-choice question test comprised of items that are demonstrated to be story dependent. The order of the comprehension tests following the oral reading is counterbalanced for the three groups (Campbell and Stanley, 1966). After the retelling task each subject is asked to report any memorable images from the story (See Table 1). Hypotheses regarding imagery are then formulated and tested against data from the study, using appropriate statistical controls.

- Table 1 About Here -

Instruments

Four instruments are used to derive indications of comprehension during and after the oral reading of the story:

Comprehension Process Score. The comprehension process score (Sadoski, 1980; Sadoski, in press; Sadoski, Page, and Carey, 1981) is

TABLE 1

Counterbalanced Task Order Design

(N=48)

Task order group	Task order 1	2	3	4
1 (N=16)	Oral reading*	Retelling & Imagery	Post oral-reading cloze	Passage-dependent multiple-choice
2 (N=16)	Oral reading*	Passage-dependent multiple-choice	Retelling & Imagery	Post oral-reading cloze
3 (N=16)	Oral reading*	Post oral-reading cloze	Passage-dependent multiple-choice	Retelling & Imagery

*generating a comprehension process score from miscues.

employed as an alternative scoring system to a complete miscue analysis (Y. Goodman and Burke, 1972). The subjects' oral reading of the story is tape recorded and the first twenty-five miscues are assessed. The comprehension process score is primarily a ratio of miscues which are semantically acceptable in the entire context of the story to miscues which are semantically unacceptable and uncorrected by the subject. The scoring range is 0-100, with higher numbers associated with more efficient semantic monitoring during oral reading. Random selection, rescoring and correlation of five data cases indicates an intrarater reliability of .96 on this variable.

Post oral-reading cloze test. The post oral-reading cloze test is identical to a conventional cloze test (Bormuth, 1975) except that the subject has had a prior oral reading of the passage (Page, 1975; Ganier, 1976; Carey, 1978; Sadoski, 1981). The passage used for this study is the first 250 words from the story. The scoring range is 0-100.

Passage-dependent multiple-choice questions. A general theory of context dependence for multiple-choice test items has been developed by Hanna and Oaster (1979). This theory contends that in the construction of reading comprehension tests, validity is maximized by including items which have context independence indices near zero, and context dependence indices that are optimal for revealing differences in performance. These indices insure that readers cannot respond correctly to test items beyond chance probability without having understood the text, and that the test will discriminate better from poorer performances. For this research, a passage-dependent multiple-choice test on the story is constructed. Nine items which include questions on

major events and characters in the story are included. The test is piloted with 72 middle grade students, yielding a mean context independence index of -.04 with a standard deviation of .11, and a mean context dependence index of .55, with a standard deviation of .10. Calculation of KR21 reliability yields .64. The test scoring range is 0-100.

Retellings. The retelling format used with stories as part of the miscue analysis procedures is employed in this study (Y. Goodman and Burke, 1972). The retelling is elicited by asking the subjects to orally recall all they can remember about the story. The researcher then uses nondirective standardized probes which do not include any text information not mentioned by the subject in order to elicit full recall from the reader. The retelling is recorded and later compared to a prepared outline of the story and scored in five categories: 1) character analysis-recall, the names of the characters in the story (0-15 points); 2) character analysis-development, information about the attitudes, behaviors, or changes in the characters (0-15 points); 3) events, details regarding the occurrences of the story (0-30 points); 4) plot, the plan or problem around which the events are organized (0-20 points); and 5) theme, the global generalization around which the story and plot are built (0-20 points). These subcategories can be totaled for a scoring range of 0-100. This type of retelling is a substance retelling (Cunningham, 1972b) in which the subject is required to successfully maintain the meaning of the original response without necessarily performing a verbatim recall. Random selection, rescoring and correlation of five data cases indicates intrarater reliability of from .94 to 1.00 on the five subscores, and .99 on total scores for this variable.

These instruments are selected with several purposes in mind. First, all these indicators have the quality of keeping the reader in a state of processing or reprocessing the ideas of the text without the addition of information from outside the story. Secondly, these indicators allow for a variety of possible text comprehension indications, including process and product measures, oral and silent reading measures, and measures which award value to convergent as well as divergent responses. This array of indicators increases the type and amount of possible subject outputs regarding comprehension of the story, a trait characteristic of more naturalistic types of inquiry (Guba, 1978). Third, these measures are all common to school reading diagnosis situations, a fact that further enhances the ecological validity of the study. Finally, these measures can be associated with different levels of processing in comprehension and memory (Craik and Lockhart, 1972). The comprehension process score, post oral-reading cloze score, and the retelling subscores of character development, plot, and theme are theoretically associated with deeper levels of processing in that the reader must attend to the integration of inferred semantic relationships in the story in order to score well on these tasks. The passage-dependent multiple-choice questions test and events retelling subscore are associated with a middle level of processing in that high scoring on these measures could be achieved through a recall of the events of the story without necessarily recognizing deeper connective relationships such as cause-effect-cause chains or hierarchical structures in the events. The retelling subscore of character recall is associated with a superficial level of processing, requiring only a recall of the characters'

names. A factor analytic study (Sadoski, 1981) determines that these measures load together on factors as theoretically predicted. These distinctions are utilized in this study as a theoretical vehicle for the interpretation of findings.

Procedures

The subjects are individually taken to the school's reading center during their normally scheduled reading time. The researcher is the school's reading consultant and a familiar figure on good rapport with the students. Subjects are put at ease by assuring them that the results of the session will not affect their grades or placement in classroom reading groups, and that the purpose of session is for general school information gathering. Students are seated at a table which is drawn up close to a blank chalkboard and away from windows and bulletin boards. The only items on the table or in the immediate area are a book, a tape recorder, and the researcher's file folder. This arrangement is used to reduce extranneous environmental stimuli, particularly visual stimuli, while maintaining a relatively "normal" school reading situation. Subjects are asked to read the story orally and without assistance for tape recording, and are informed of the comprehension tasks to follow but are not informed that they will be asked a question about imagery. As soon as each task is completed, subjects are given the next task in order to keep them in a constant state of processing the story, either in text or from memory. The entire procedure takes approximately 1 hour per subject. At the completion of the retelling task for each subject a question regarding imagery is asked: "Do you have any pictures or scenes in your mind that you remember from this story?"

Observation and hypothesis generation

Several observations indicated differences in imagery reporting. A primary observation was that reported imagery was often rich, varied, and frequently unrelated to the illustrations of the story. Subjects usually reported original story images with the same degree of vividness as images associated with story illustrations, and seldom made distinctions between them. Another primary observation was the frequency of reports of an image of the climax of the story, an event which was not specifically illustrated. Over half the subjects reported some image of the boy scientist's sister locked in a dark closet and/or the boy lowering the flashlight to her. In total, only two subjects (4%) reported no imagery at all; six subjects (13%) reported only images associated with one or more of the story illustrations but no further images; nine subjects (19%) reported images associated with story illustrations plus other images which did not involve the climax of the story; six subjects (13%) reported only images not associated with either story illustrations or the climax of the story; and twenty-five subjects (52%) reported an image of the climax of the story either alone or with other images from the story. The subjects reporting climax imagery reported only slightly more total images than subjects not reporting climax imagery (mean reported images for climax groups = 2.9, standard deviation = 1.7; mean reported images for non-climax groups = 2.2, standard deviation = 1.5. The higher mean for the climax imagery group is largely due to one subject who reported 12 images). No subjects reported imagery not associated with the story. On the basis of these observations one research question is selected for investigation: To what extent, and in what manner, is reported climax imagery related to the comprehension measures derived from the subjects in this study?

Analysis and results

Two groups are identified in order to explore the research question. These groups are emergent in nature, as described by Guba (1978, p. 14). One group is composed of subjects reporting climax imagery (N=25) and one group is composed of subjects not reporting climax imagery (N=23).

In the counterbalanced design used in this study, determining relatively unbiased relationships between reported imagery and the other variables in the study is approached through relating the imagery variable with the other variables while controlling for the tasks in the design performed after the initial reading of the story but prior to the imagery question. The counterbalancing present in the design yields no statistically significant task order group differences on the variables derived from the reading of the story (Note 1.). While this allows data to be collapsed across task groups for analysis, no assumption is made that the counterbalanced design alone controls for all sources of bias in the imagery variable that may have been introduced by performing prior tasks. Such tasks could bias the subjects either toward or away from reporting certain types of imagery through interactions involving additional text processing, interference, etc. In an attempt to nullify any remaining bias, multivariate analysis of covariance (MANCOVA) and partial correlation techniques are employed in conjunction with the controls inherent in the counterbalanced design to detect relationships.

Since the separate subscores of the retelling task are theoretically representative of a relatively complete spectrum of processing levels, and would therefore yield analysis fruitful for theoretical interpretation, a MANCOVA is undertaken using the imagery groups as the

independent variable and the vector of the retelling subscores as the dependent variable. Since the post oral-reading cloze test and the passage-dependent multiple-choice questions were administered prior to the retelling and imagery question in two task order groups, and may have had an effect on the retelling and/or reported imagery, they are covaried in the analysis. Additional tests are included to determine if there are differences on the retelling subscores vector between task order groups, or if there are any interactions between task order groups and image groups. This series of analyses is undertaken to determine: 1) if the identified image groups differ significantly on the retelling subscores vector. 2) if this difference might be due to differences in task order groups or some interaction between task order groups and image groups, and 3) to assess and control for any effects that the cloze and multiple-choice tasks might have had on the vector in any group.

Using the Wilk's criterion, findings demonstrate significant difference in the retelling subscore vectors of the two image groups ($F = 3.88$, $df = 5/36$, $p < .007$), but no significant difference across task groups ($F = 1.60$, $df = 10/72$, NS), and no significant task order group by image group interactions ($F = 1.28$, $df = 10/72$, NS). These findings define a significant difference on the retelling subscore vectors of the image groups that cannot be associated with task order group differences, task order by image group interactions, or the effects of the additional processing afforded by the cloze and multiple-choice tasks. A follow-up discriminant function analysis is performed to determine which of the five subscores are contributing to the significant difference between image groups. Table 2 shows standardized discriminant function weights,

univariate F ratios, and significance levels for the retelling subscores. Comparisons indicate two significant contributors, events and theme, with higher scores on these variables associated with the reported climax imagery group. A third retelling subscore, plot, reaches borderline significance, and also favors this group.

- Table 2 About Here -

To determine further relationships between reported climax imagery and the remaining variables in the study, partial correlation is employed. This technique is used in an attempt to nullify the effects that intervening variables might exert on the correlation of one variable with another (Blalock, 1964). A reasonably unbiased approximation of each separate relationship between reported imagery and the remaining variables in the study can be determined by respectively partialing for all the other relevant variables in the design. The retelling total score, the additive sum of the retelling subscores, is partialed for these analyses. Comprehension process scores are not partialed because this score is derived from the initial reading of the story and therefore could not affect the imagery variable through additional processing, interference, etc. Zero-order correlations, variables partialed, and significance levels are given in Table 3. Positive correlations indicate a relationship with reported climax imagery, negative correlations indicate a relationship with no reported climax imagery. Comprehension process

TABLE 2

MULTIVARIATE AND UNIVARIATE IMAGE GROUP DIFFERENCES ON RETELLING SUBSCORES

(N=48)

SOURCE OF VARIATION	VARIABLE	SDFC* Group 1	SDFC* Group 2	Univariate F (df=1/40)	p <
Image group, controlling for effects of post oral-reading cloze and passage-dependent multiple-choice tests	Character recall	-.222	.204	0.01	NS
Group 1=climax imagery not reported (N=23)	Character development	.112	-.103	0.17	NS
Group 2=climax imagery reported (N=25)	Events	-.522	.480	9.14	.004
	Plot	-.261	.240	3.06	.088
	Theme	-.487	.448	5.36	.026

*Standardized discriminant function coefficients. Constants have been eliminated for comparisons (Group 1 constant= -.970; Group 2 constant= -.850).

scores are found to correlate significantly and positively with reported climax imagery. Standardized reading test scores reach borderline positive significance with reported climax imagery. The passage-dependent multiple choice test reaches borderline negative significance with reported climax imagery.

- Table 3 About Here -

Discussion

Reported climax imagery appears to have significant relationships with several reading comprehension variables in this study. Substantial positive relationships are found between reported climax imagery and knowledge of the events of the story and the story theme. A substantial positive relationship is found between reported climax imagery and comprehension process scores, which are indicative of effective semantic monitoring of the text while reading. A borderline negative relationship is found between reported climax imagery and the passage-dependent multiple-choice test questions used in this study. Positive relationships of borderline significance are found between reported climax imagery and knowledge of story plot and standardized reading test scores. No significant relationships appear to exist between reported climax imagery and knowledge of character names and character development, post oral-reading cloze tests, or verbal mental ability tests. The finding of no significant task group by image group interaction when the tasks prior to the retelling and imagery question are covaried tends to suggest a degree of stability for climax imagery over at least short periods of time. Findings

TABLE 3

Zero-order (r) and Partial (r_p) Correlations With Reported Climax Imagery

(N=48)

Variable	r	P <	Variables Partialed	r_p	P <
Comprehension process score	.344	.008	Post oral-reading cloze, passage-dependent multiple-choice, retelling total	.327	.014
Standardized reading test*	.190	.098	Post oral-reading cloze, passage-dependent multiple-choice, retelling total	.215	.079
Verbal mental ability test**	-.051	NS	Post oral-reading cloze passage-dependent multiple-choice, retelling total	-.0127	NS
Post oral-reading cloze	-.040	NS	Passage-dependent multiple-choice retelling total	-.180	NS
Passage-dependent multiple-choice	-.178	NS	Post oral-reading cloze, retelling total	-.223	.068

*reading subtest of the Metropolitan Achievement Test (1978).
**Otis-Lennon School Ability Test (1979)

also suggest that story illustrations are not necessarily related to producing memorable imagery.

A theoretical interpretation of these findings can be proposed that is consistent with contemporary imagery theory, particularly the theories of Paivio (1971) regarding the relationships between visual imagery and verbal processes. Paivio (1971) contends that visual imagery and verbal processes are alternative mental coding systems for the symbolic representation of meaning. Imagery is theorized to be relatively better at coping with concreteness, transformations, and the parallel processing of spatial information, is largely free of logical restraints, and is more rapid than verbal processes. Verbal processes are theorized as being superior in abstract and sequential processing, and contribute logic, order, direction, and organization. A central element in this theory is the "conceptual peg" hypothesis (Paivio, 1963) which contends that certain images serve as mental "pegs" to which associated information is hooked for comprehension and retrieval.

Interpreting the findings of the present study from this theoretical perspective might propose the climax image as a "peg" or placeholder to which other story information is associated. In recalling this story, the rapid arousal of the climax image of the story may have served as a basis from which the remainder of the story was retrieved and reconstructed. The substantial relationship between climax imagery and recall of story events follows in that the climax is an event itself, and also in that the other events in the story are imageable as well, and are linked with the climax by the structural framework of the story's plot. The markedly lower relationship between the plot retelling subscore and reported climax imagery can be accounted for in that a story plot

is a sequential, ordered, and relatively logical entity which is theoretically processed and comprehended better through the verbal mode. Both the borderline relationship of climax imagery with the plot retelling subscore and the lack of a significant relationship between climax imagery and the character development retelling subscore may be interpreted in light of the contention that there is a mutual and reciprocal relationship between plot and character development. Abrams (1965, p. 69) contents that there is a sliding boundary between the two concepts wherein either one of the concepts can be expanded to take over more and more of the other's area of meaning. Considering Paivio's (1971) processing distinctions, this may suggest that the analysis of plot and character development is interdependent, and they are together better processed by the sequential and logical capabilities of the verbal system. A significance correlation between the retelling subscores of plot and character development found in this study ($r = .349$ $p < .008$) supports this interpretation. The lack of any relationship between verbal mental ability and reported imagery in this study further supports a dual-coding interpretation.

The substantial relationship found in this study between climax imagery and knowledge of the theme of the story also has an established theoretical basis. Pompi and Lachman (1967) determine that recognition of a unified theme in meaingful discourse initiates surrogate processes and structures wherein readers store some arrangement of words, visual images, and schemata that may reflect the "essential ideas" of the passage (p. 14). They state: "Indeed, the general theme or idea of a passage may be thought of as one huge chuck containing much information in the sense that it is the nucleus

of a complex matrix of associations. This chunk may be part of what is meant by the 'meaning of a passage'." (Pompi and Lachman, 1967, p 148). The notion that an image of the climactic event of a story can serve as a mental placeholder for story information and interpretation is consistent with this suggestion. In studies directly comparable to Pompi and Lachman's (1967), Yuille and Paivio (1969) and Montague and Carter (1973) both conclude that imagery may play an important role in the storage of a theme, particularly when the discourse involved has very imageable content. Yuille and Paivio (1969) suggest that imaginal representation of theme may be the basis of the surrogate processes. If Pompi and Lachman's (1967) surrogate structures theory is true, and if the conclusions of these imagery studies are correct, some of what is currently referred to as schemata may be more accurately described in terms of imagery.

The substantial correlation between climax imagery and comprehension process scores also has theoretical support. Pompi and Lachman (1967) noted thematically associated "false-positive" errors when subjects were asked to report words they recognized from coherent stories. Yuille and Paivio (1969) report a similar "theme related errors" finding, and Montague and Carter (1973) report a similar "synonym intrusion" effect. These terms all refer to the tendency of readers to recall words which did not actually appear in the text of the story, but were semantically acceptable to the thematic meaning of the story. Similar such semantically acceptable deviations from materials have been noted in still other imagery studies (Begg and Paivio, 1969; Begg, 1971; Anderson and Hidde, 1971; Kulhavy and Swenson, 1975). The substantial correlation between climax imagery and comprehension

process scores in this study suggests that this tendency may be directly related to the tendency of oral readers who are attending to the deeper meaning aspects of a story to make semantically acceptable miscues (K. Goodman, 1969). The proportion of miscues which are semantically acceptable in the entire context of the story is what is primarily measured by the comprehension process score (Sadoski, 1980). Such miscuing may be seen as the overt manifestation of ongoing deep structure activity, which may involve imagery. Imaging may also be the cause of certain miscues. These points are discussed further below.

The notion that climax imagery may serve as a placeholder for thematic meaning and as a retrieval device for story information is consistent with levels of processing theory (Craik and Lockhart, 1972). The theoretical association between climax imagery and the reading variables in this study associated with deeper levels of processing is accordant if Paivio's (1971) theoretical distinctions between imagery and verbal processes are considered. Climax imagery exhibits significant relationships with comprehension process scores and theme retelling subscores, both of which are theoretical deep processing indicators, and have feasible theoretical associations with imagery. Climax imagery exhibits a borderline significant relationship with plot retelling subscores, another deep processing indicator. The lower magnitude of this relationship may be due to the suggested predilection of the verbal system for comprehending and storing sequential and ordered information such as plot information. The lack of a relationship between climax imagery and the theoretically deep processing variable of character development can be explained using the same rationale, if plot and character development are indeed reciprocal, as suggested

by Abrams (1965). The lack of a relationship between climax imagery and post oral-reading cloze scores, the final theoretical deep processing variable identified in this study, may be due to the nature of the cloze task, which substantially involves the parsing of sentences and may also be heavily dependent on syntactic verbal processes (Gould, 1979).

Reported climax imagery in this study exhibits a significant relationship with the theoretically middle level processing variable of the events retelling subscore. This is consistent in light of the rationale that the climax is a key imageable event among other imageable and related story events. The negative partial correlation of borderline significance between reported climax imagery and the theoretical middle-level processing variable of passage-dependent multiple-choice questions may have several explanations. This negative correlation associates subjects that achieved relatively higher scores on the passage-dependent multiple-choice test with imagery other than climax imagery, but not necessarily any less imagery, as both groups reported about the same number of images. Perhaps images of the story's illustrations and other non-climax story images were more closely associated with information needed to answer the test questions, which covered all the main events and characters in the story. Another explanation may be that suggested by Tuinman (1979), who contends that in constructing multiple-choice test items we are often compelled to ask clever questions about story information that would normally not be deeply processed by readers, and to construct item response alternatives which maximize logical verbal reasoning in deciding which alternative is best. The characteristic of passage-dependency in multiple-choice test questions insures that the use of text information is necessary to achieving high scores.

This effect may minimize reader input and maximize the comprehension of literal aspects of the text (Pearson and Johnson, 1978). As reported climax imagery appears to be associated primarily with deep-processing variables, a low negative correlation with passage-dependent questions may then be expected. The borderline significant positive correlation between climax imagery and the standardized reading test may be explained using a related rationale. The standardized reading test used in this study employs multiple-choice comprehension items, but these items have not been demonstrated to be passage-dependent in the manner that the test items developed especially for this study were. The standardized reading test may therefore have required more reader schema activation and input from deeper levels of processing, thereby establishing a positive correlation with reported climax imagery, which appears related to deeper processing. However, multiple-choice reading comprehension tests of either of these varieties likely invoke verbal processes heavily because of their inherent reliance on verbal reasoning, and there is evidence that such tests load heavily on a general verbal factor (Tuinman, 1979; Carver, 1973). These conditions would tend to restrict substantial correlations with imagery in any case, if in fact verbal processes are significantly distinct from imagery processes (cf. Cramer, 1980).

The retelling subscore of character recall, the identified superficial processing variable in this study, does not exhibit a significant relationship with reported imagery. This may be due to the verbal nature of the task, which involves recalling character names, and/or to the general association of imagery with deeper levels of processing. However, a ceiling effect is found in the data for character recall in

this study, since most of the subjects recalled all the characters in the story. This effect may be somewhat suppressing correlations here, making interpretation of this variable difficult. Also, this variable may vary greatly from story to story. Collectively, however, the pattern of relationships outlined here suggests that climax imagery in this study is related to relatively deeper levels of semantic and cognitive representation, and is consistent with theories that images serve to mentally store some aspects of meaning, while verbal representations are better suited to store other aspects of meaning.

Current research provides evidence of a positive relationship between visual imagery and learning (Horowitz, 1970). Olshavsky (1977) has concluded that readers use an array of problem solving strategies in comprehending, and although the use of imagery was not an identified strategy in that study, certain of the reported protocols suggest that readers may have been using imagery in comprehending story text. Huttenlocher (1968) has concluded that imagery is used in both spatial and verbal problem solving in reading situations. Anderson and Kulhavy (1972) report visual imagery as a spontaneously occurring prose learning strategy. These studies suggest that imagery may be used in ways beyond the boundaries of verbal language to comprehend, learn, and solve problems. Twining (1980) suggests that this is true in literary encounters. Kaufmann (1979, 1980) has developed a theory that visual imagery is functionally significant in general problem solving, particularly in unfamiliar or novel situations. If this theory holds true for the utilization of problem solving strategies in the reading of stories, imaging may well have functioned here as a strategy in story comprehension. In the present research, the climax of the story involves a boy's constructing a unique home-made flashlight and lowering it into a

dark closet through a transom vent to aid his frightened sister. This situation involves novelty and problem solving for the character in the story, and poses a novel situation to the reader wherein imagery may have been used in comprehending the event and the unfolding of the solution to the character's problem. Accordingly, the subjects may have been employing imagery as a strategy in comprehending this novel and prominent event by visualizing the actions of the character as the event proceeded. The use of such a strategy might well involve a greater amount of selective attention and a deeper level of processing, resulting in better comprehension and a more embellished and persistent memory trace (Craik and Lockhart, 1972).

However, Brooks (1967, 1970) and Levin and Divine-Hawkins (1974) have demonstrated both with adults and children that attempting to read and image at the same time presents difficulties, and that reading may suppress visualization. Two suggested explanations for these findings are that reading and visualization compete for the same neural pathways, and/or that reading hinders the conversion of verbal input into non-verbal representation (Brooks, 1967). Given these findings, it may be inferred that disruptions in the reading process should be evident while readers are actively imaging. In order to investigate this possibility in the present study, ratios of miscues per hunderd words for the entire story (MPHW) to miscues per hundred words for the climactic event of the story (CMPHW) are compared between the group reporting climax imagery and the group not reporting climax imagery. The group reporting climax imagery exhibits a mean CMPHW to MPHW ratio of 2.94, with a standard deviation of .76, while the group not reporting climax imagery exhibits a mean CMPHW to MPHW ratio of 2.90, with a standard

deviation of .77, indicating that all subjects were making an average of nearly three times as many miscues during the climax as during the story as a whole. This finding is consistent with the inference that active imaging may have been disrupting reading at this point and suggests that imaging may be the cause of some miscues. Alternative explanations for this finding may involve an increase in information density or concept load during the climax, but imaging exists as a highly possible factor. The lack of any significant difference between the imagery groups on CMPHW could suggest that while most readers may have been imaging during the story climax, not all may have been processing to the same depth or perceiving the significance of the climax in the story's structural hierarchy and then associating that significance with the climax image as a referent. It is feasible that those subjects who did attach signficance to climax imagery employed imagery both as a problem-solving strategy and as a mental placeholder for the story's thematic meaning. These subjects would be more likely to report this imagery than subjects who may have used imagery as a problem-solving strategy but did not attach thematic meaning to the image, thus diving the subjects into the two broad groups that emerged in this study.

Limitations and Implications

While the limitations of this exploratory study allow for few absolute conclusions, its implications are numerous. The study described here involves forty-eight fifth graders reading a single story, and the possibility that these findings are idiosyncratic to this data

set must be observed. However, the sampling model employed assures a wide variety of student traits and abilities, and the subjects of this study are amply representative of a considerably larger population. The sample includes virtually the entire fifth grade of a suburban American school, and to the extent that these students are like other such students, logical generalizations can be made regarding the particular story used here. Nonetheless, replications with other students reading this story and other stories are called for before specific conclusions can be stated.

The design of the study is an unconventional combination of experimental and naturalistic inquiry. It is experimental in the sense that there are experimental controls inherent in the counterbalanced design, in the particular materials and tasks selected, and to some degree in the elimination of extraneous stimuli in data gathering. It is naturalistic in that the independent variables emerge without a priori assumptions as the investigation proceeded, in that a variety of subject outputs were encompassed, and in that the tasks and data gathering procedures were ecologically valid for school reading clinic situations. In this way elements of both discovery and verification are combined in one study which reflects both naturalistic and experimental research paradigms to an extent (cf. Carey, 1980). In effect, the design becomes a variable in such studies. The complexity of detecting and sorting out relationships among the variables in such designs calls for involved multivariate statistical procedures. While appropriate cautions were observed here, data gathered in a strictly experimental fashion might discern somewhat different results.

Another limitation on the conclusions of this study involves the possible confounding of the retelling and imagery reporting. The

imagery question was used as the final probe in the retelling task for all subjects, and the imagery reported may have at least partially been a result of the prior reprocessing of the story from memory. The investigator's observations, however, would tend to suggest that this effect was not critical: subjects did not always report images of what they had just retold, sometimes reported images of things they had not retold, and many who had ample recall of the climax of the story did not report an image of it. Moreover, there appeared to be no apparent pattern in the retellings regarding sequence, organization, or amount of unprobed vs. probed recall that would distinguish the groups. The only observation regarding imagery that seemed noteworthy during the data gathering was that better readers tended to report original imagery more consistently, while less capable readers tended to report text illustrations more consistently. This observation is somewhat confirmed by the statistical findings. However, climax imagery could still have been employed by readers who did not report it, as imagery does not necessarily have to be consciously experienced to be effective (Paivio, 1971). Disentangling such relationships is troublesome in imagery research, and the design of many studies in this area has been characterized by elaborate experimental controls. Such studies, while valuable as demonstrations, may be guilty of implicitly shaping possible outcomes by unavoidably linking variables (Guba, 1978). While the present study has a more naturalistic leaning that allows for discovery, it may not be entirely free of such effects. Statistical controls have a degree of usefulness here, but many problems remain to be solved in imagery research methodology.

Observing these limitations, a number of implications can be drawn from this study. Imagery appears to be both naturally present and functional in children reading in school situations. Original imagery appears to be as significant and robust as text illustrations in school reading situations, an implication in accord with conclusions that text illustrations seem to neither help nor hinder text comprehension (Samuels, 1970; Concannon, 1975; Rasco, Tennyson, and Boutwell, 1975). While better readers did not report significantly more imagery in this study, reported imagery of the climax of the story is related to better performances on those reading comprehension variables that are theoretically associated with deeper levels of processing and do not rely disproportionately on sequential, logical, verbal processing. Reported climax imagery correlates either insignificantly or negatively with variables that theoretically rely heavily on verbal processes. Reported climax imagery also correlates substantially with a measure reflecting miscues which are semantically acceptable in the context of the story, a finding that suggests further support for the contention that such miscues are indicative of reading for meaning (K. Goodman, 1969). The finding that readers miscued at nearly a 3:1 ratio during this story's very imageable climax tentatively suggests support for Brook's (1967, 1970) implication that imaging may disrupt reading, and for Kaufmann's (1979, 1980) theory that imagery can be used as a problem-solving strategy. However, while reported climax imagery can be associated with better reading comprehension and recall in this story, other stories with less prominent, novel, or imageable climaxes may have other imageable events which better function as a storage or support system for comprehension and recall, while still other stories may

engage little imagery at all. The functional use of imagery is seen as flexible, and interacting with verbal processes reciprocally. These implications are not inconsistent with imagery theory, schema theory, or theories of story grammar and macroscructure in text, and in fact complement such theories.

Perhaps the most noteworthy implication of this study is the strong support for the imagery theories of Paivio (1971) and for the surrogate structure theory of Pompi and Lachman (1967). The findings of this study tend to both confirm and extend many of the particulars of those theories, especially the notion of dual coding as defined and elaborated by Paivio (1971, 1974) and the thematic storage notion of Pompi and Lachman (1967). Also, Paivio's conceptual peg metaphor for phrases (Paivio, 1963) and its extension to sentences (Paivio, 1971) can be seen as tentatively extended here to children reading a complete story in a school setting.

A summary set of speculations might propose that imagery can serve as a placeholder for thematic meaning, that both imagery and thematic meaning are arrived at through the process of elaboration, and that they converge at a deep level of processing. Sadoski (1981) contends that theme comprehension may be elaborated as the reader processes through the story, moving between various processing levels as necessary. This process may be conceived as a cycle, wherein the reader alternately approaches the text at relatively superficial processing levels for specific information, and then withdraws to deeper processing levels to integrate the information into an overall understanding. It may be during this deep processing, withdrawl phase of the cycle that readers elaborate plot and character development, thematic

information, and significant original images. Readers with a strong sense of the hierarchical arrangement of story events (i.e. well developed story schemas) may better recognize the significance of climactic event and link thematic meaning to imagery of this event. This deeper, more elaborate processing may yield a stronger memory trace that is useful in recalling the story. Such a suggestion is consistent with virtually all of the theory discussed in this study, and is not inconsistent with theories of the relationship between imagery and brain hemisphericity, reading comprehension, and affect (cf. Cramer, 1980; Kinsbourne, 1981; Bugelski, 1970).

Summary and Conclusions

Despite the general and specific limitations of this exploratory study, it would appear that imagery has natural functional utility in the comprehension and recall of stories read in schools by children. Support is tentatively concluded for the dual coding and conceptual peg aspects of Paivio's (1971) theories, and for the surrogate structure theories of Pompi and Lachman (1967). Support is suggested for Kaufmann's (1979, 1980) theories of imagery in problem solving, for Brook's (1967, 1970) theories of visualization and reading, and for levels of processing theory in comprehension and memory (Craik and Lockhart, 1972). Speculations are forwarded for the manner in which imagery might interact with verbal processes and story schemas in story comprehension and recall, and for the way in which imaging may be related to miscuing in oral reading. The convergence of theories from various types of investigation used in interpreting the findings of this study synthesizes logically, and invites further research in this area.

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Reference Notes

1. Analysis of variance was performed across task order groups for each variable in the study's counterbalanced design. No significant differences were found on any of these variables, indicating true counterbalancing in the data. ANOVA results: comprehension process score ($F = .192$, $df = 2/45$, NS); post oral-reading cloze test ($F = .334$, $df = 2/45$, NS); passage-dependent multiple-choice test ($F = .078$, $df = 2/45$, NS); retelling total scores ($F = 2.022$, $df = 2/45$, NS).